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GEOLOGY.—*The amount of the geologically recent negative shift of strand line on Oahu.*[1] JAMES B. POLLOCK, University of Michigan. (Communicated by H. H. BARTLETT.)

Many observers of islands of the Pacific region from the early explorers to the present time have noted evidence of change of strand line in the form of raised coral reefs, of elevated terraces and wave-cut benches above present sea level in both elevated limestones and on volcanic shores. The earlier observers interpreted these facts as indicating the elevation of the lands in relation to a constant sea level. More recently the view has been presented that such changes may have been due to a lowering of sea level relative to a stable land.

If the latter is the correct interpretation it could hardly do otherwise than affect the whole ocean, and evidence for the same amount of shift should be found in widely separated localities in all the oceans. Of course local differential movements might mask or even completely hide the evidence for the general shift, yet if the shift has actually been a general change of sea level the evidence must be available in many localities and the exact mount of the shift becomes of prime importance. It has been difficult for observers to determine from a study of wave-cut benches and sea caves where the sea level stood during the time when the caves and benches were cut, and different men in the same region have interpreted the evidence differently. On the Island of Tutuila, American Samoa, Daly[2] noted sea caves cut at the present sea level and their relation to that level, compared them with similar caves cut at the higher level before the

[1] Paper number 272 from the department of Botany, University of Michigan. Received December 5, 1927.

[2] DALY, R. A. *The Geology of American Samoa.* Carnegie Inst. Washington Dept. Marine Biology **19**: 95–143. 1924 (Publication 340).

last shift, and concluded that the shift was 6 meters or 20 feet. Chamberlin,[3] studying wave-cut benches in the same region, thought the shift was somewhere from 12 to 20 feet, and most likely 12 to 15 feet.

Wentworth and Palmer[4] studied the wave-cut benches on the Hawaiian Islands, and concluded that a negative shift of the strand line here occurred later than the origin of the youngest tuff cones on Oahu, to the amount of about 12 feet, or somewhere between 10 and 15 feet.

Todd and Hoffmeister[5] conclude that the benches they observed indicated a shift of 6 to 8 feet on Fiji and 9 to 10 feet on Tonga.

The author had a sojourn of two years in the Hawaiian Islands, from the summer of 1922 to that of 1924, during which period he made a study in considerable detail of the coral reefs on Oahu, both living and fossil. Incidental to this study certain observations seemed to establish the fact that the amount of the shift on Oahu, estimated by Wentworth and Palmer at about 12 feet, was really more nearly equal to that estimated by Daly for Tutuila, Samoa. It is the object of this paper to present the evidence for this conclusion.

The locality in which the decisive observations were made was on the east shore of Pearl Harbor on the Island of Oahu, the location of the great Naval Station of the United States in the Pacific Ocean region.

Pearl Harbor consists of a series of broad, pouch-like bays commonly known as the Pearl Lochs. The outlets of all the lochs converge to a single channel which forms the entrance to the harbor.

At an early stage of its development Pearl Harbor was a broadly open bay which during long geological time has become largely filled, in part with calcareous deposits of all the kinds of material found on the neighboring coral reefs, in part by detritus from erosion of the surrounding highland, and in part by volcanic tuff. The latter is particularly in evidence on the eastern shore of the harbor near which is a considerable number of craters known as the Salt

[3] CHAMBERLIN, R. T. *The Geological Interpretation of the Coral Reefs of Tutuila, American Samoa.* Carnegie Inst. Washington Dept. Marine Biology **19**: 145–178. 1924.

[4] WENTWORTH, C. K. and PALMER, H. S. *Eustatic Benches of Islands of the North Pacific.* Bull. Geol. Soc. Amer. **26**: 521–544. 1925.

[5] TODD, H. S. and HOFFMEISTER, E. *Recent Negative Shift in the Strand Line of Fiji and Tonga.* Journ. Geol. **35**: 542–556. 1927.

Lake craters, since one of them is so near sea level that it always contains a small lake in which there is a deposit of salt on the bottom at low stages though it is not connected directly with the sea. All the craters in this vicinity have been long extinct but during the period of their activity whenever they were in a state of eruption quantities of fine ashes drifted on the northeast trade wind toward the southwest forming a broad, gently sloping ridge from the Salt Lake craters to the channel entrance of Pearl Harbor. This deposit of volcanic ash was one of the major factors in the partial closing of the broad outlet of the original bay, converting it into a nearly closed series of lochs.

Immediately adjacent to the east short of Pearl Harbor is a small crater known as Makalapa crater. The highest point of its crater rim is about 100 feet above sea level and on one side it slopes down rather steeply to the Pearl Harbor shore. At the foot of this slope runs the Oahu railway and the cuts along its right of way afford some opportunity to see the formation of the region. On this slope are located the great oil tanks which the Doheny oil interests constructed for the United States navy. In laying the foundations for these tanks and digging the trenches for the pipe lines connecting the oil tanks with the pumping station, slopes were leveled down, depressions in the land were filled up, and in the process the materials composing the land of this region were disclosed to a considerable depth below the land surface from near sea level to an elevation of about 50 feet above that level. Some of the oil-pipe ditches were excavated to a depth of 35 feet below the surface of the tuff. Preliminary to the work of construction of the oil tanks this region was surveyed with contour lines having a vertical interval of ten feet, and stakes were set to mark the contour levels. The construction engineers very kindly allowed the author access to the blue prints of the survey, and with the stakes marking the contour lines it was possible to get very accurately the elevation of any given spot within the limits of the survey. Along several of the trenches for the pipe lines, observations were made of the calcareous deposits laid down during the last period when the sea stood higher than its present level, that is, the period during which were cut the benches observed in many localities in the Hawaiian Islands by Wentworth and Palmer. Those observers state that the eustatic shift took place much later than the origin of the most recent tuff craters on Oahu, and in the Koko Head region they found the bench of the time preceding that shift cut into the

tufaceous materials at the base of those craters. They also assert that the Salt Lake craters are enormously older than those of Koko Head region. They were therefore completed before the shift of strand line and might be expected to exhibit in one way or another evidence of the sea level before the shift.

Even with the sea 20 feet higher than its present level, Pearl Harbor would still be a more or less inclosed bay, and the shore in the region of Makalapa crater would be protected from the great waves of the open ocean by the extension of the low ridge previously described, running from the Salt Lake craters to the Pearl Harbor outlet. Perhaps because of this protection the sea, during its higher level, made calcareous deposits but did not cut a bench around Makalapa crater. It was fortunate that the author was able to make his observations of these deposits during the period of construction of the oil tanks, and he is under obligation to the construction engineers for the opportunity of seeing their blue-prints and obtaining the information as to the elevation of significant materials. They frequently informed him whenever any such materials were opened up to inspection. It was chiefly owing to this assistance that the amount of the last shift of strand line could be fixed with a nearer approximation to accuracy than had previously been done.

Though the accuracy of survey lines was available only around the Makalapa crater, observations pointing to the same general conclusions were made along the outlet channel where the low ridge of tuff from the Salt Lake craters meets that channel. The shore cliff in that vicinity is composed of the tuff layers separated by thin sheets of calcareous material in its lower portions, but these tuff layers are capped by a continuous deposit of calcareous material in which coral fragments, shells, etc., are embedded in calcareous sand. In this locality calcareous deposits were traced to an elevation of 15 feet but the highest limit was not determined. In neither of these two localities, Makalapa crater and the harbor channel, were calcareous deposits seen at an elevation higher than 25 feet above present sea level, though in other localities within Pearl Harbor, namely, on Ford Island and the Waipio peninsula, there are calcareous deposits up to an elevation of about 40 feet. These facts indicate very clearly that deposits of tuff from the Makalapa crater and in the lower part of the ridge from the Salt Lake craters were laid down subsequently to any submergence of Oahu that was greater than 25 feet, and that when the last eruption from these craters

occurred and for some time afterward, the sea stood somewhat less than 25 feet higher on the land than it does at present.

The calcareous deposits used to determine the highest level at which they occurred were mostly in pockets or depressions around the base of the Makalapa tuff cone, and some of them may still be seen in part along the railway cut in this vicinity. It is likely, however, that the upper portions of all of them in this region have been completely hidden or removed in the extensive operations in the construction of the oil tanks, and will never again be open to observation. Even though the upper portions had been covered up by tuff carried down over them by rain, the sections along the pipeline ditches, running up the slopes as they did, made complete exposures of the depth and elevation of the calcareous deposits.

The field notes of the observations, written for each on the spot at the time the observation was made, show that at five different points within the Makalapa area a record was made of the highest elevation at which the calcareous deposits appeared. At two of these points traces of calcareous material were recorded as occurring up to 25 feet, but more marked at 22 to 23 feet. Two others were recorded as at 22 feet, and one at 21 to 22 feet. At the highest level the materials were in very thin layers, fine-grained and friable. At slightly lower levels shells and coral fragments were recognizable, and still lower, clumps of coral that might have been in place as they grew. In one pocket there were quantities of a bryozoan.

Critical facts in these observations are that the extreme elevation at which any of the calcareous materials were seen in this region was 25 feet above present sea level; that these highest layers were thin, fine-grained and friable, like the sand at the top of the sea beach; that at about 22 feet these deposits were greater in quantity, and at least one exposure at this level was seen to contain shells and coral fragments; that at still lower levels the number of coral fragments increased; and that at about 15 feet there was a bed of coral that seemed to have grown in place where it was seen.

In the interpretation of these facts it was assumed that the highest calcareous deposits, those at 25 feet elevation, were at the top of the beach above high tide, and the question was presented, how many feet would this be above high tide. As an aid in answering this question it had been noted that on a shore where the waves came in from the open ocean but were broken by a coral reef a few hundred feet off shore, the highest part of the sandy beach was 7 feet above high

tide. In the region around Makalapa crater, where there would be not only the protection from the waves of the open ocean afforded by the coral reef off the entrance of Pearl Harbor, but also the added protection afforded by the ridge of tuff previously mentioned, it is believed that the highest part of the beach would be not more than five feet above high tide at the most. High tide level of the period before the last shift would therefore be 20 feet above present sea level, and the calcareous materials seen at 22 feet, may still have been tossed up by the waves 2 feet above high tide. Since the range of the tide in the Hawaiian Islands is three feet, the tide range as a whole was at least 17 feet higher in the time preceding the shift than at present.

There is still a little uncertainty on two points as to the correctness of these figures. In the first place it may be that in this protected situation and on a steep shore the waves would not deposit materials as much as five feet above high tide. Perhaps it would be only four feet instead of five. In that case the range of tide for the earlier time would be from 18 to 21 feet higher than at present. The second point of uncertainty is due to the failure of the writer to note whether the sea level used by the engineers in charge of the oil tank construction was "mean tide level" or "mean low tide." The difference is one and one-half feet. It is believed the latter was the sea level datum used by them, which agrees with the figures first given. If, however, the other datum was the one used, the whole tide range of the earlier period would be one and one-half feet higher. Accepting both uncertainties we may say that in the period preceding the last shift of strand line the sea stood higher than at present by an amount between 17 and 20 feet on the Island of Oahu. This conclusion can be drawn with a very high degree of certainty as to its accuracy.

The author believes he has presented more reliable data than any previous writer whose work is known to him as a basis of approximating the amount of the last land-sea level shift on the Island of Oahu, whatever the final conclusion which will be reached as to whether it was a shift of land or a shift of sea. It is impossible to know how much wave-cut benches were lowered below the level of the sea that cut them, hence the uncertainty of the conclusions of Wentworth and Palmer, as well as those of many others. Sea caves also may have quite different dimensions in relation to the sea that excavated them, depending on the resistance of the materials in which they are excavated. The good fortune which allowed the recognition of the

materials characteristic of the beach above high tide in continuation with those of a lower level, coupled with the opportunity of determining the elevation above sea level by accurate surveys, all make for a higher degree of accuracy than has previously been attained.

As to whether the shift was an elevation of the land or a lowering of water, the most convincing evidence for the latter will be the proof that around many islands as well as along the shores of the continents there has been a similar shift in the same direction and of a similar amount. If the shift was one of the land the chances are almost infinitely against its being of the same degree in many widely separated localities in all the oceans, while if there was a lowering of the water it would within a short time affect all the lands in all the oceans. Of course it must be granted that local shifts of the land may mask or entirely hide the effects of a change in water level, nevertheless it is of great importance to determine as exactly as possible, the amount of apparent shifts of land or sea wherever found. It would seem that the evidence of wave-cut benches such as those observed by Wentworth and Palmer should be interpreted to mean a higher sea level at which they were cut than those authors were led to believe. Also, the interpretation of Chamberlin in Tutuila, Samoa, based on wave-cut benches, is likewise probably too low, and should allow a greater shift than he supposed, or at least it should be the upper limit of his allowance, namely about 20 feet. Sea caves, which are cut partly above and partly below tide level, may, in all probability, be a safer guide to the former sea level than wave-cut benches. If we accept Daly's interpretation of the former sea level on Tutuila, which was based on the sea caves, the shift in Hawaii is practically identical with that in Samoa, in direction and degree.

CONCLUSIONS:

1. The last negative shift of strand line on Oahu involved a change of land-sea level somewhere from 17 to 20 feet.

2. This agrees very closely with the findings of Daly on Tutuila, Samoa, and is greater than Wentworth and Palmer believed was indicated by the evidence furnished by the wave-cut benches on Oahu and other islands of the Hawaiian group.

PALEONTOLOGY.—*A caddis case of leaf pieces from the Miocene of Washington.*[1] EDWARD W. BERRY. (Communicated by JOHN B. REESIDE, JR.)

The aquatic larvae of the so-called caddis flies (*Trichoptera*) construct a variety of protective cases of a variety of materials. These are frequently fossilized, and are especially liable to be encountered in continental deposits, since the larvae inhabit all sorts of fresh water environments.

Last year I described[2] a new type of fossil caddis case constructed of leaf pieces, which occurs very abundantly in the lower Eocene (middle Wilcox) of western Tennessee, in what were interpreted as lagoonal deposits. These cases were broad and depressed, and were neatly constructed of symmetrically cut pieces of drift leaves.

The habit of utilizing leaf fragments in the construction of the cases of the larvae—the so-called caddis worms or caddis fly worms—has, of course, been frequently noted among existing forms, and is especially pronounced in the family Limnophilidae. The architectural plan adopted varies both with the species and with the seasons, but in no case are the leaf pieces known to be as symmetrically uniform as in this lower Eocene form, although this is approximated in the genera *Glyphotaelius* and *Pycnopsyche*. Consequently the pseudogeneric term *Folindusia* was coined for the fossil form made of leaf pieces, in conformity with the term *Indusia*, which has long been used for generically indeterminable fossil caddis cases of the familiar sand grain type.

The new Miocene species which is the subject of this note may therefore be referred to *Folindusia*, and described as

Folindusia miocenica Berry, n. sp.

Cases relatively large, depressed, two faced with sharp edges, somewhat over 3 times as long as wide, decreasing slightly in width from in front backward, amounting to about 1 millimeter in a length of 2.5 centimeters. Size ranging from 1.5 to 2.5 centimeters in length by 4 to 7.5 millimeters in width. Constructed entirely as far as observed of relatively small vegetable fragments. In the specimen figured these are all small and irregularly cut fragments of leaf blades, but in smaller cases fragments of small sticks or perhaps pieces of petioles ("ballast sticks") are incorporated, and in one specimen a long piece of this kind occupies one margin. Both monocotyledonous and dicotyledonous leaves are mined and there is apparently no selection since, although the fragments are much too small to be determined,

[1] Received December 12, 1927.

[2] EDWARD W. BERRY. U. S. Nat. Mus. Proc. 71(14): 1927.

observed differences in texture and areolation of the pieces in a single case show that several species of leaves are represented, and that the "worm" did not get all of its building material from a single leaf. The number of pieces on one face of a case amounts to slightly in excess of 50, which is in striking contrast to the Eocene species *Folindusia wilcoxiana* in which the number was from 5 to 8.

Folindusia miocenica was found in the fine grained, diatomaceous clays of the Latah formation at the Brick-yard exposure in Spokane, Washington. These clays carry an especially rich, varied, and well preserved mesophytic terrestrial flora of later Miocene age amounting to over 150 species. The conditions of deposition have been interpreted by Pardee and Bryan[3] as lacustrine, and due to stream damming by flows of the so-called Columbia lavas.

The philosophy of such flat cases is obviously to prevent them from being readily capsized or rolled to the consequent discomfort of the relatively small occupant, and consequently such cases may be considered as evidence of some current action.

The present species is obviously distinct from *Folindusia wilcoxiana* in the larger number of much smaller and more irregular leaf pieces used. It probably belongs in the same family, Limnophilidae, incidentally a rather large and widely distributed group, which is especially prominent in the faunas of ponds and slow streams.

Figure 1.—*Folindusia miocenica* Berry, n. sp. × 3. Miocene of Spokane, Washington.

BOTANY.—*Studies of Venezuelan Bignoniaceae.—I.* Ceratophytum, *a new genus of vines.*[1] H. PITTIER, Caracas, Venezuela.

The genus *Adenocalymna* was fully described for the first time by P. de Candolle[2] from notes and Brazilian specimens left by von Martius. It included originally 19 species, one of which (*A. bra-*

[3] J. T. PARDEE and KIRK BRYAN. U. S. Geol. Survey Prof. Paper **140**: 15–16. 1927.

[1] Received December 9, 1927.

[2] D.C. Prodr. **9**: 199.

chybotrys) is doubtful, another one (*A. Guillemini*) has not been seen again by modern monographers of the genus, and the remaining 17 are characterized by the biseriate disposition of the ovules, with the exception of *A. macrophyllum* and *A. Salzmanni* for which this character has not been ascertained. Two of the other species (*A. floribundum* and *A. plicifolium*) have since been transferred, the first one to *Arrabidaea* and the second to *Memora*. Besides, *Adenocalymna splendens*, created in 1896 by Bureau and Schumann, and which shows 8-seriate ovules, lately became the type of Hassler's genus *Chodanthus*.

It seems evident, first, that the intention of the authors of genus *Adenocalymna* was to include in it only species with biseriate ovules, and secondly, that most modern students of the group have supposed this arrangement to be a fundamental character. If we consider, then, that we have in the two species described hereafter a third type of such arrangement, namely an 8-seriate disposition of the ovules, and also, that the shape and size of the fruit is absolutely *sui generis*, the tendrils always trifurcate and the insertion of the inclosed stamens densely villous, their separation to form a distinct genus will appear as sufficiently justified. Besides, the affinities of the group would be with *Haplophytum* or with *Distictis Mansoana*, rather than with *Adenocalymna*.

On account of the likeness of the capsule of the type species to a goat's horn, I propose for the new genus the name of *Ceratophytum*, which is self-explanatory.

Ceratophytum Pittier, gen. nov.

Calyx tubuloso-campanulatus apice truncatus vel subquinquedentatus, extus lepidotus, plus minusve distincte glandulosus, intus glaber, eglandulosus. Corolla tubuloso-campanulata basi in tubo contracta, apice lobata lobis subaequantibus suborbiculatis, extus plus minusve dense puberula intus prope insertionem staminum dense villosa. Stamina manifeste didynama inclusa, thecae glabrae, divaricatae; staminodium breve, filiforme. Discus annularis vel cupulatus, conspicuus. Ovarium sessile, lateraliter compressum, plus minusve sulcatum vel angulatum cum stylo obsolete articulatum, ovulis numerosis, 8-seriatim placentis binis pro loculo affixis anatropis; stigmata subfoliacea. Capsula magna elongato-linearis, septo parallele compressa, apicem versus attenuata; extus sublaevis, septifrage dehiscens. Semina applanata, alata, alis membranaceis, subhyalinis, interdum apicem truncatis—Frutices scandentes, vulgo glaberrimi. Folia decussata plerumque ternata vel interdum conjugata cirrho terminali 3-furcato clausa; phylla stipulas simulantia non notata. Flores majusculi, speciosi, albi vel partim lutescentes, racemos umbelliformes decussatos terminales referentes, bracteis bracteolisque minoribus deciduis vix notatis. Species 2, venezuelenses.

Ceratophytum capricorne Pittier, sp. nov.

Frutex scandens, ramis crassis, cortice griseo, rugoso verruculis cicatricibus foliolorum delapsorum intermixtis obtectis, ramulis teretibus, laevibus, glaberrimis, parce lenticellatis, longitudinaliter striatis; foliis membranaceis

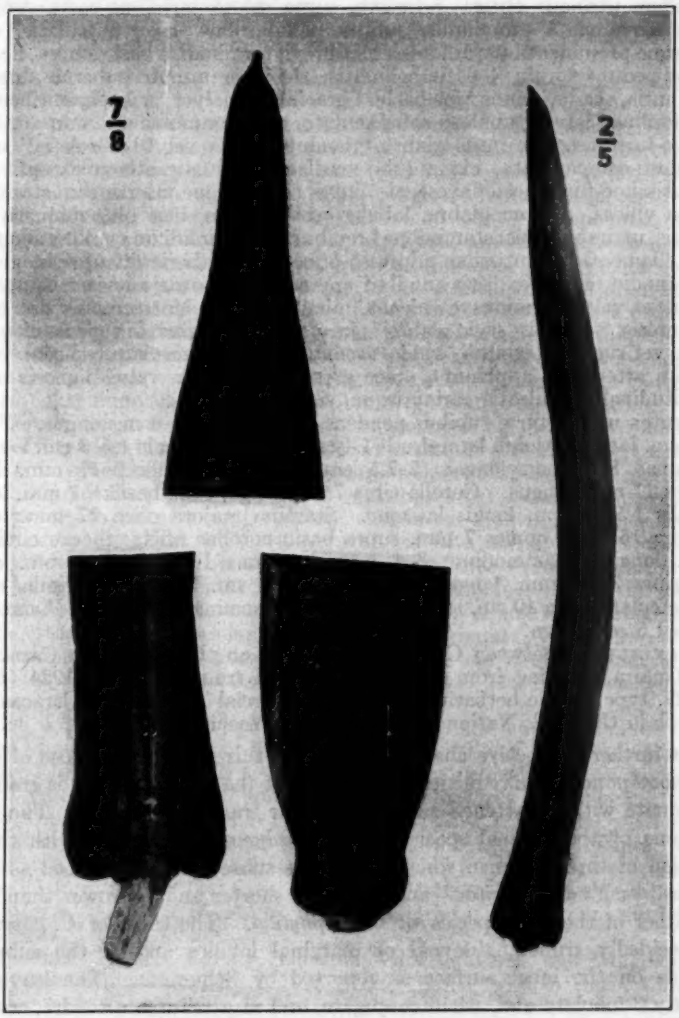


Figure 1.—Right side: Capsule of *Ceratophytum capricorne*, full view reduced to ⅔ natural size. Left side: above, apex of same, front view; below, side (left) and front view of base, all reduced to ⅔ natural size.

glaberrimis, vel novellis vix puberulis, plerumque ternatis, summum interdum conjugatis cirrho terminali trifurcato clausis, longe petiolatis, petiolis teretibus, supra obsolete canaliculatis; petiolulis modice longis supra anguste canaliculatis, terminali longiore; laminis late ovatis obovatisve basi rotundatis subcuneatisve, apice late rotundatis brevissime et obtuse acuminatis interdum utrinque obtusis retusisve, supra solute viridibus costa venisque primariis circa 5 prominulis, subtus pallidioribus, laxe reticulatis, costa venisque prominentibus; inflorescentia brevi, terminali, e basi ramosa, floribus apice pedunculorum 4–6 umbellulatis, rhachide minute puberula, bracteis diminutis, caducissimis; pedicellis gracilibus calyce subaequantibus vel longioribus; calyce tubuloso-campanulato, apice truncato vel sinuato, extus rufulo-furfurescente, intus glabro, glandulis nullis vel 10 obsoletis; corolla tubuloso-campanulata, extus tubo basilari brevi aurantiaco excepto alba minutissime furfuraceo-flavescente, intus flava, prope insertionem staminum dense villosa, demum glabra, lobulis orbicularibus, basi plus minusve contractis, utrinque albis; staminibus brevibus, circa dimidium corollae aequantibus, filamentis minutissime adpresso-puberulis, antheris divaricatis, glabris, staminodio filiformi; disco annulari crasso glabro; ovario leviter compresso, anguloso vel plus minusve sulcato, minutissime lepidoto; ovulis pro loculo numerosis, 8-seriatis; stylo glabro apicem versus attenuato; capsula elongata, laevi vel rugulosa, glabra, valde arcuata, lineari-lanceolata, apicem versus sensim attenuata, applanata, apice grosse mucronata, valvis lignosis medio longitudinaliter sulcatis carinatisque; seminibus alatis.

Frutex ut videtur e rupibus pendens, multicaulis, 5–6 m. longus. Petioli 3–8 cm. longi; petioluli laterales 1–1.4 cm. longi, terminale 1.5–3 cm. longum. Laminae 8–10 cm. longae, 5–7.5 cm. latae. Pedicelli 9–17 mm. longi. Calyx 11 mm. longus. Corolla circa 7 cm. longa, tubo basilari 7 mm. longo, lobulis 1.5–1.6 cm. longis latisque. Stamina majora circa 27 mm. longa, minora 15 mm., omnes 7 mm. supra basin corollae affixa; thecae circiter 3 mm. longae; staminodium 3–4 mm. longum. Discus 1.5–2 mm. altus. Ovarium 3.5–4 mm. longum; stylus 3.1–3.3 cm. longus. Capsula crasse pedunculata circa 40 cm. longa, 3.8 cm. lata; semina cum alis 4.5–5 cm. lata, circa 1.5 cm. longa.

VENEZUELA: Between Catia and Blandín, on the road from Caracas to La Guaira, hanging from rocks; flowers and fruits May 11, 1924 (*Pittier* 11527, type, in the herbarium of the Commercial Museum at Caracas, and cotype in the U. S. National Herbarium at Washington, D. C.).

As further distinctive characters between this species and those of genus *Adenocalymna*, we may mention the length of the capsule, which is gradually attenuate with a flattened subquadrangular transverse section. The fruits of none of the original species of *Adenocalymna* are known, with the exception of three cases in which they were subsequently described as "*subteretes*" or "*subcylindricae*" and as much shorter and narrower than those of either of the two species of *Ceratophytum*. The calyx of *C. capricorne* is decidedly truncate, devoid of marginal lobules and of the subsessile glands on the inner surface as reported by Schumann. The leaves are mostly 3-foliolate and, when conjugate, end in a trifurcate tendril, whereas this is described as simple in every case when it has been observed in the *Adenocalymna* species.

It is most certain that a more complete comparative study of more copious materials will show further divergences. For the present I only indicate those which happened to strike me and at the same time express my conviction that genus *Adenocalymna*, as constituted at present, is an heterogeneous and unsustainable complex.

Ceratophytum brachycarpum Pittier, sp. nov.

Frutex alte scandens, ramis crassis, angulosis, ramulis glabris, striatis, copiose verruculosis, cortice griseo vel nigrescente obtectis; foliis longe petiolatis plerumque ternatis, interdum conjugatis cirrho terminali glabro, valido, 3-furcato clausis; petiolis gracilibus, teretibus, striatis, parcissime lenticellatis, supra anguste canaliculatis; petiolulis brevibus, striatis, canaliculatis, terminali lateralibus vix duplo longiore; foliolis coriaceis ovatis, basi plus minusve obliquis subemarginatisve et leviter complicatis, apice subacuminatis obtusisve, supra laete viridibus, opacis, costa impressa, venis venulisque prominulis, subtus vix pallidioribus, glandulis impressis praecipue secundum costam interspersis, costa venisque circa 6 prominentibus, venulis laxe reticulatis prominulis; inflorescentia brevi, modice pedunculata, pedunculo crasso puberulo, floribus pedicellatis ad apicem pedunculorum secundariorum umbellulatis; pedicellis puberulis calycem plus minusve aequantibus; calyce campanulato, margine scarioso irregulariter parceque dentato, plus minusve distincte glanduloso, glandulis nigrescentibus elongatis, demum extus dense lepidoto, irregulariter glanduloso, glandulis globosis, intus laevi; corolla alba (in sicco cinnamomea), tubuloso-campanulata basi in tubo brevi angusto contracta, lobulis suborbicularibus, imbricatis, subaequantibus, extus furfuraceo-velutina, intus lobulis et insertione staminum dense villosa exceptis glabra; staminibus glabris, filamentis quam corollae tubo dimidium brevioribus, antheris divaricatis; staminodio filiformi; disco annulari-cupulato, plus minusve plicato et margine sinuato; ovario leviter applanato, lateraliter sulcato, extus lepidoto, ovulis pro loculo numerosis, 8-seriatis; stylo modice longo, glabro, stigmatibus lanceolatis; capsula crassa, lignosa, applanata, subrecta vel arcuata, lineari-lanceolata, apicem versus attenuata, grosse mucronata, extus laevi, villoso-punctulata, punctis impressis, valvis medio leviter canaliculatis, basi bigibbosis, seminibus alatis.

Petioli 4.5–7.5 cm. longi; petioluli laterales 0.7–2.4 cm., terminales 1.5–3.7 cm. longi; laminae 8.5–13 cm. longae, 4.5–9 cm. latae. Pedunculi primarii 1.5–3 cm., secundarii 0.5–1 cm. longi; pedicelli 1–1.5 cm. longi. Calyx 1 cm. longus, supra 7 mm. diam. Corolla circa 7 cm. longa, tubo basilari 6 mm. longo, lobulis 1–1.5 cm. longis, 1.3–1.7 cm. latis. Stamina majora circa 2.3 cm., minora 1.5 cm. longa, omnes circa 8 mm. supra basin tubo affixa; thecae 4 mm. longae; staminodium 5 mm. longum. Discus circiter 1.5 mm. altus. Ovarium circa 4 mm. longum; stylus plus minusve 3 cm. longus. Capsula 16–24 cm. longa, 3 cm. lata; semina cum alis circa 3.3 cm. lata, 1.4 cm. longa.

VENEZUELA: Near Garabato, between Villa de Cura and Magdaleno, Aragua; flowers and fruits May 7, 1925 (*Pittier* 11805, type, in Herb. Comm. Mus., Caracas, co-type in U. S. National Herbarium, Washington, D. C.). La Sanguijuela, between Alpargatón and Urama, Carabobo, fruits December 17, 1920 (*Pittier* 9153); vicinity of El Sombrero, Guárico, in light forest; flowers and fruits April 17, 1927 (*Pittier* 12366); near Sarare, Lara, in light forest; flowers and fruits April 9, 1925 (*Pittier* 11754).

This species differs from the preceding in the coloring of the corolla, the dimensions of the several parts and, principally, in the size of the capsules and seeds. Besides, the valves of the capsule are copiously punctate, a character not perceptible in those of *C. capricorne* and the glandular system is more developed in the leaves, calyx and corolla.

Before closing this contribution, I wish to add that the type-specimens of both species have been submitted to Mr. Sprague, the well known authority on the *Bignoniaceae*, who concurred in the opinion that they represent a new genus. I am sincerely obliged to him for his kindly aid.

ZOOLOGY.—*New marine mollusks from Ecuador.*[1] PAUL BARTSCH, United States National Museum.

A recent shipment of mollusks collected by Mr. J. M. Reed, of Guayaquil, Ecuador, at Salinas in Guayaquil Bay, for the Southern California Conchology Club, and transmitted by that Club to the U. S. National Museum for determination, contains a number of new things which are here described.

This collection as well as the two transmitted by Dr. R. A. Olsson[2] some time ago from which we also described a lot of new material, show that the region in question offers rich opportunities to the careful collector, and it is hoped that more work of the kind will be done here to make known to us that fauna. I am informed that the sponsors and heaviest backers of Mr. Reed's expedition have been Messrs. A. M. Strong, W. L. Brown, and C. E. White.

Mangilia whitei, new species
Fig. I.—1.

Shell small, elongate-conic, white with two slender reddish-brown bands which cover the two spiral threads anterior to the suture. The axial sculpture consists of broad, rounded ribs which are only slightly elevated at the summit and increase rapidly toward the middle of the space between the suture and summit and then again decrease anteriorly toward the suture, disappearing shortly after reaching the base. The spaces that separate these ribs are about half as wide as the ribs. The spiral sculpture consists of rather broad cords which are separated by channels almost as wide as the cords. Of these cords, 7 occur between the summit and the suture. Suture well constricted. Base attenuated, slightly concave on the left side, marked by 13 low, broad spiral threads. Aperture oval, strongly channeled anteriorly and moderately notched at the posterior angle, the outer lip

[1] Published by permission of the Assistant Secretary of the Smithsonian Institution. Received December 28, 1927.

[2] *New Mollusks from Santa Elena Bay, Ecuador.* Proc. U. S. Nat. Mus., No. 2551, 66: 1–9, *pls. 1–2*. *Additional new mollusks from Santa Elena Bay,* Ecuador. Proc. U. S. Nat. Mus., No. 2646, 69: 1–20, *pls. 1–3*.

reinforced within by a strong callus which bears 9 poorly developed lirations on the inside, the strongest one of which is immediately anterior to the posterior notch, from which they grow consecutively weaker anteriorly; there is a strong varicial-like rib immediately behind the aperture on the outside.

The type (Cat. No. 367966 U. S. N. M.) has 7 whorls, and measures—length, 5.3 mm.; greater diameter, 2.5 mm.

Olivella guayaquilensis, new species

Fig. I.—10.

Shell of medium size, elongate-ovate with the spire decidedly elevated; the first 5 turns flesh-colored, the fifth flesh-colored with a narrow brown zone near the summit and another in the suture; the last whorl is flesh-colored with a narrow brown zone at the summit, and another zone about 3 times as wide separated from this by a pale zone about as wide as the dark zone at the summit; this is followed by a broad light spiral zone which is as wide as the broad spiral brown zone immediately posterior to the first fold of the base; a narrow brown zone is present on the anterior half of the first fold and a much broader one which extends over almost half the base anterior to the second fold; the interior of the aperture is yellowish-white with 2 broad spiral bands of brown, one at the posterior angle and the other extending anteriorly from the middle; the extreme outer edge of the aperture is yellowish-white. The whorls are polished, scarcely marked by incremental lines; microscopic spiral striations are present. Suture narrowly channeled. Periphery rounded. Base rather stout, marked by 2 conspicuous folds below the periphery and 4 oblique threads on the columellar border. Aperture moderately broad, acutely channeled posteriorly, moderately deeply notched anteriorly; outer lip thin at the edge; inner lip strongly reflected as a heavy callus bearing the folds referred to above; parietal wall marked by a rather stout callus.

The type (Cat. No. 367975 U. S. N. M.) has 7 whorls, and measures—length, 15.6 mm.; greater diameter, 6 mm.

Olivella salinasensis, new species

Fig. I.—12.

Shell oval with the spire very short; early whorls flesh-colored, later ones pale brown, the last with vermiculations, arrow-shaped markings and dashes of yellowish-white, the points of the arrows being protractively directed; the interior of the outer lip is mottled at the edge, and brownish-flesh-colored within. The first 3 whorls form a mucronate apex, the next 3 expand very rapidly and are separated by a rather deeply impressed channeled suture; the last whorl is marked by fine retractively slanting, incremental lines and microscopic spiral striations. Suture channeled. Base moderately long with a single impressed line a little anterior to the periphery; the parietal and basal callus are marked by folds of which the first two are slender, and these are about one-fourth of the length of the aperture anterior to the posterior angle of the aperture; they are followed by a heavy fold which in turn is followed by two a little less conspicuous, succeeded by a narrower one which is followed by 2 heavy folds which in turn are followed by 2 a little less strong; the outer lip is thin; the aperture is narrowly channeled posteriorly and deeply notched anteriorly.

The type (Cat. No. 367976 U. S. N. M.) has almost 7 whorls, and measures—length, 10.7 mm.; greater diameter, 5.2 mm.

Mitra salinasensis, new species

Fig. I.—16.

Shell rather large, oval; early whorls flesh-colored with a narrow zone of brown posterior to the suture; the last whorl chestnut-brown, a little paler on the posterior two-thirds between summit and suture; the interior of the aperture dark chestnut-brown except the posterior zone just referred to; the folds on the columella are bluish-white. The first 3 whorls are marked by 5 rather strongly incised spiral threads which are not quite of equal width or spacing; on the next turn these become much enfeebled, and on the last they are altogether lost; the entire surface of the last whorl is marked by fine incremental lines and fine spiral striations. Suture moderately constricted. Periphery well rounded. Base moderately long, the anterior half marked by 14 spiral threads which grow consecutively stronger from the middle of the base anteriorly, and likewise more closely approximated. Aperture somewhat lunate, conspicuously channeled anteriorly; outer lip thin; inner lip bearing 4 conspicuous folds which grow consecutively weaker from the posterior anteriorly, and which are of equal spacing.

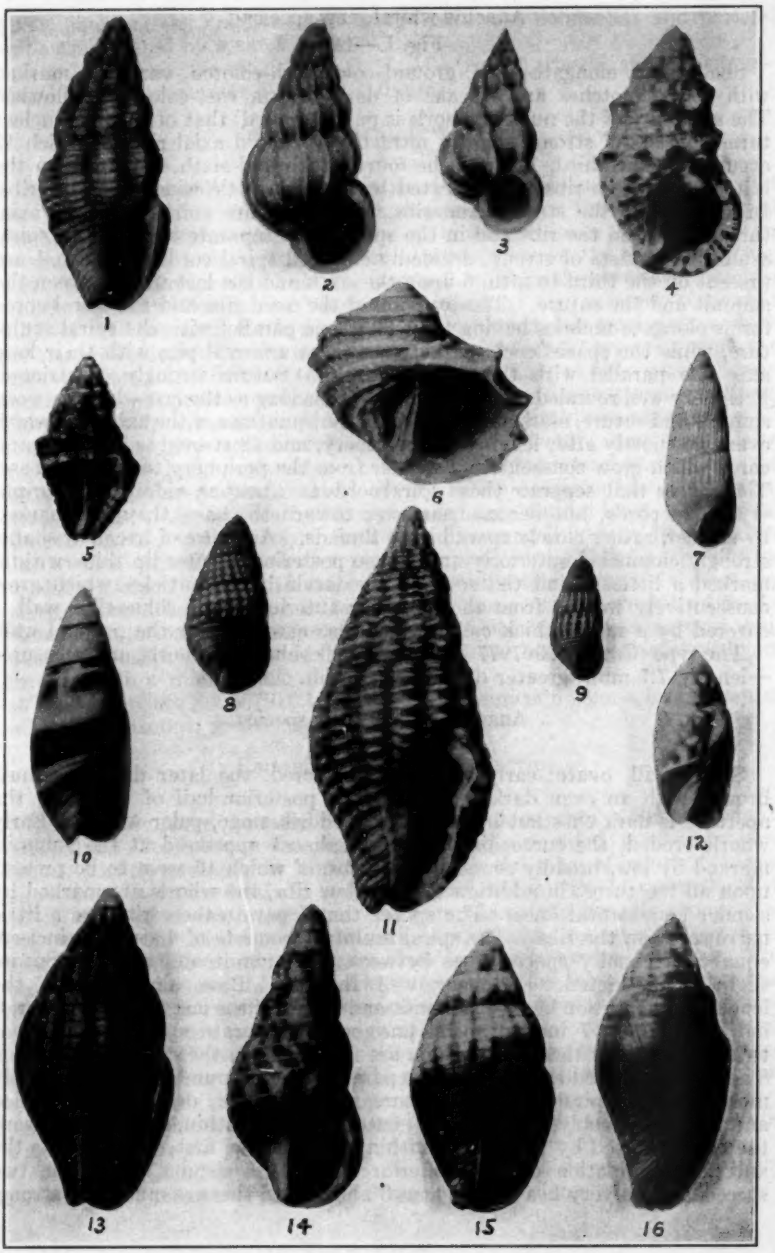
The type (Cat. No. 367982 U. S. N. M.) had 6 whorls, and measures—length, 27.8 mm.; greater diameter, 12.7 mm.

Engina mantensis, new species

Fig. I.—5.

Shell moderately large, chestnut-brown, paler at the tip with a conspicuous yellowish band immediately below the periphery. Early whorls decollated. Postnuclear whorls marked by 10 axial ribs on each turn which are almost truncated on the middle of the turns and fade rapidly posteriorly while anteriorly they extend to the umbilicus; on the early whorls these ribs show above the suture as a series of nodules; on the last turn the nodule becomes bifid; on the base 6 additional series of nodules are present; these nodules in reality are the intersection of strong spiral cords and the ribs; in addition to these stronger spiral cords, less conspicuous spiral threads are present which are separated by spaces about as wide as the threads; of these threads, 17 are present between the summit and the suture on the last turn. Base about four times as long as the space between the summit and the periphery on the last turn, marked in addition to the stronger nodules by spiral threads of the same strength as those on the spire. Aperture irregular in outline, white within but brownish on the outer lip except where the light zone is present; strongly channeled anteriorly and less so posteriorly; the posterior channel is rendered conspicuous by a heavy callus on the parietal wall and on the outer lip; the outer lip also bears in addition to the strong spiral lamella bordering the posterior channel 5 spiral lamellae anterior to the light zone; a series of 8 slender, short spiral lamellae are present on the parietal wall and posterior half of the inner lip; the anterior half of the inner lip is reflected over the columella with a very heavy callus.

The type (Cat. No. 367970 U. S. N. M.) was collected by Mr. Jones at Manta, Ecuador. It has 6 whorls, and measures—length, 17.2 mm.; greater diameter, 9.3 mm. This specimen has been in the collection of the U. S. National Museum for some time and is not part of the material received from the Southern California Conchology Club.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Anachis whitei, new species

Fig. I.—11.

Shell small, elongate-conic, ground color flesh-colored, variously marked with spots, blotches and streaks of dark brown, rust-color or yellowish. The sculpture of the nuclear whorls is partly eroded; that of the postnuclear turns consists of strong, slightly retractively curved axial ribs, of which 12 occur upon the third, 14 upon the fourth, fifth and sixth, and 16 upon the last turn. These ribs are separated by spaces a little wider than the ribs. In addition to the strong axial ribs, the whorls are marked by fine axial threads both on the ribs and in the spaces that separate them. The spiral sculpture consists of strong, decidedly elevated spiral cords, of which 4 are present on the third to fifth, 6 upon the sixth and the last turn between the summit and the suture. The junction of the axial ribs and the spiral cords forms elongate nodules having their long axis parallel with the spiral sculpture, while the spaces enclosed between them are oval pits with their long axis also parallel with the axial sculpture. Suture strongly constricted. Periphery well rounded. Base about twice as long as the last whorl between summit and suture, marked by the feeble continuations of the axial ribs which evanesce shortly after leaving the periphery, and 13 strongly elevated spiral cords which grow consecutively weaker from the periphery toward the base. The spaces that separate these spiral cords are about as wide at the periphery as the cords, but become narrower toward the base; they are marked by slender, rather closely spaced axial threads. Aperture of irregular shape, strongly channeled anteriorly and less so posteriorly; outer lip thick within, marked a little behind the edge on the inside by 6 denticles which grow consecutively weaker from the posterior anteriorly; the columellar wall is covered by a rather thick callus which also extends over the parietal wall.

The type (Cat. No. 367977 U. S. N. M.) has almost 8 whorls, and measures —length, 7.7 mm.; greater diameter, 3.4 mm.

Anachis strongi, new species

Fig. I.—13.

Shell small, ovate; early whorls flesh-colored, the later dark chestnut-brown, with an even darker band on the posterior half of the base; the aperture is dark chestnut-brown with a reddish tinge, paler within. Early whorls eroded, the succeeding turns are almost appressed at the summit, marked by low, broadly rounded axial ribs, of which 16 seem to be present upon all the turns; in addition to these low ribs, the whorls are marked by slender incremental lines. The spaces that separate these ribs are a little narrower than the ribs. The spiral sculpture consists of 4 strongly incised, equal and equally spaced lines between the summit and suture. Suture slightly constricted. Periphery well rounded. Base almost twice the length of the portion between summit and suture of the last turn, the anterior half marked by 7 incised spiral lines which separate spiral bands about twice as broad as these lines which are flattened; on the columellar portion 8 additional incised spiral grooves separate an equal number of considerably more elevated spiral cords. Aperture rather narrow, decidedly channeled anteriorly and feebly so posteriorly; outer lip thick within, narrowing toward the edge, marked by 7 denticles within, of which the first, which marks the anterior termination of the posterior channel, is slender, while the two succeeding are very heavy; the next 3 anterior to this are much less strong,

about equaling the first, the last being feeble; the columellar and parietal walls are covered by a thick callus.

The type (Cat. No. 367978 U. S. N. M.) has 5.5 whorls, and measures—length, 6.0 mm.; greater diameter, 3.0 mm.

Anachis reedi, new species

Fig. I.—15.

Shell small, broadly ovate, flesh-colored with a narrow zone of brown at the suture and a broad zone of much darker brown on the anterior third of the base; the posterior two-thirds being of the same color as the zone anterior to the periphery; the interior of the aperture shows the same zonation, with the ground color a little darker flesh-colored than the exterior. Nuclear whorls eroded. Postnuclear whorls appressed at the summit, somewhat inflated, well rounded, marked with feebly developed, low axial riblets which are merely indicated on the early turns, and of which 20 are present on the last volution. In addition to these axial ribs, fine, closely spaced incremental lines are present on the ribs as well as the spaces that separate them. The spiral sculpture consists of 5 strongly incised spiral lines which are most conspicuous in the intercostal spaces. Suture feebly impressed. Base about twice as long as the space between the summit and the suture, the extreme posterior portion marked by the feeble continuation of the axial ribs, and the entire surface by closely spaced incremental lines. The spiral sculpture consists of 5 deeply incised continuous spiral lines on the posterior third which separate broad, low rounded spiral cords, and 13 strongly incised lines which separate 12 rather strong, well rounded spiral cords on the anterior two-thirds of the base which grow consecutively weaker from the posterior anteriorly. Aperture oval; outer lip thick within, bearing 4 conspicuous denticles on its middle half; the inner lip and parietal wall are covered with a thick callus.

The type (Cat. No. 367979 U. S. N. M.) has almost 6 whorls, and measures —length, 5.3 mm.; greater diameter, 2.8 mm.

Epitonium strongi, new species

Fig. I.—2.

Shell rather large, broadly elongate-conic, white, thin. Nuclear whorls decollated. Postnuclear whorls inflated, strongly rounded, marked by very broad, slightly retractively curved, lamellar axial ribs, of which 14 occur upon the first and second, 16 upon the third and fourth, 14 upon the fifth and sixth, and 16 upon the last. These riblets extend equally strong over the whorls from the summit to the periphery, and on the last whorl over the base to the umbilicus, here, however, they become somewhat reduced. The broad spaces between the axial riblets are marked by incremental lines and microscopic, very closely spaced spiral striations which, however, become apparent only under very high magnification. Suture strongly constricted. Periphery inflated, well rounded. Base short, strongly rounded, marked by the continuation of the axial ribs which become fused at the umbilical region. Aperture broadly oval, peristome continuous, reinforced by a callus which replaces the columella on the inner lip and which is marked by 6 spiral threads; the rest of the peristome is considerably thickened.

The type (Cat. No. 367967 U. S. N. M.) has lost the nuclear turns; the 7.5 remaining measure—length, 15.9 mm.; greater diameter, 8.5 mm.

Epitonium reedi, new species

Fig. I.—3.

Shell of medium size, broadly conic, white with a flush of brown on the last turn which is particularly emphasized on the basal portion thereof. The last two turns of the nucleus are present and appear to be smooth. Postnuclear whorls inflated, strongly rounded; the first postnuclear whorl is marked by 14 slender, only slightly elevated, almost vertical axial riblets; on the second postnuclear turn only 10 axial riblets are present, and here they are much more elevated and also somewhat thicker with a decided angle about one-third of the distance between the summit and the suture anterior to the summit. This state of affairs obtains on the third and fourth turn, but here the angle becomes dulled, and the ribs increase materially in thickness; on the rest of the turns the angle is lost, but the axial ribs become very much thickened and are marked by a series of lines of growth; they are also conspicuously posteriorly reflected. Ten of the axial ribs are present upon all the whorls except the first; the spaces separating the axial ribs are marked by 6 spiral threads between the summit and suture which are of about the same strength and spacing on the first postnuclear whorl; the spaces separating these threads are about as wide as the threads. On the second postnuclear turn the spiral threads become obsolete on the posterior half of the whorls between the summit and suture, but remain strong on the anterior half, the posterior half being marked by numerous slender, closely spaced spiral threads; the basal portion of the intercostal spaces on the last turn are also marked by conspicuous spiral threads, while the ribs here are very much thickened and become fused at the umbilicus. Aperture broadly oval; the outer and basal lip very much thickened, that of the parietal wall a little less so, while on the inner lip the shell is reinforced by a rather strong callus which shows spiral markings.

The type (Cat. No. 367968 U. S. N. M.) has 8.5 whorls (having lost the extreme nuclear tip) and measures—length, 12.7 mm.; greater diameter 6.8 mm.

Turbonilla (Turbonilla) salinasensis, new species

Fig. I.—7.

Shell small, elongate-conic, bluish-white. Nuclear whorls 2.5, forming a depressed helicoid spire whose axis is at right angles to that of the succeeding whorls, in the first of which the nuclear spire is about one-fourth immersed; the left outline of the nuclear spire projects very slightly beyond the left side of the postnuclear turns. The first 4 postnuclear whorls are slightly rounded, the rest almost flattened, weakly shouldered at the summit and marked by retractively curved axial riblets which are about twice as wide as the spaces that separate them; of these riblets, 30 occur upon the second of the postnuclear turns, 26 upon the third and fourth, 36 upon the fifth, 38 upon the sixth and the last turn. These ribs extend fairly strong to the summit of the turns which they slightly crenulate. The intercostal spaces, on the other hand, are but feebly impressed and terminate a little posterior to the suture, leaving a narrow smooth zone in the suture. Suture moderately constricted. Periphery well rounded. Base moderately long, well rounded, marked by slender incremental lines. Aperture oval; posterior angle acute; outer lip thin; inner lip slightly curved and slightly reflected, adnate to the preceding turn for almost half its length; parietal wall glazed with a very thin callus.

The type (Cat. No. 367972 U. S. N. M.) has 7 postnuclear whorls, and measures—length, 3.7 mm., greater diameter, 1.2 mm.

Odostomia (Crysallida) salinasensis, new species

Fig. I.—8.

Shell small, elongate-ovate, bluish-white. Nuclear whorls small, deeply, obliquely immersed in the first of the succeeding whorls, above which about half of the tilted edge of the last portion only projects. Postnuclear whorls slightly rounded, feebly shouldered at the summit, marked by retractively curved, broad, low rounded axial ribs, of which 18 occur upon the first and second, 24 upon the third and fourth, and 26 upon the last turn. These ribs are considerably wider than the spaces that separate them. The spiral sculpture consists of 4 strong threads between summit and suture which render the axial ribs conspicuously nodulose; the spaces between the broad spiral threads are less than half the width of the threads. Suture strongly channeled. Periphery with a rather strong channel. Base moderately long, marked by 6 strong spiral cords; the spaces separating these spiral cords are a little wider than the cords and are crossed by slender axial threads. Aperture oval; posterior angle acute; outer lip thin at the edge; inner lip strongly curved, provided with an oblique fold at its insertion; the parietal wall covered by a moderately thick callus.

The type (Cat. No. 367973 U. S. N. M.) has 6 whorls, and measures—length, 3.2 mm.; greater diameter, 1.5 mm.

Odostomia (Crysallida) reedi, new species

Fig. I.—9.

Shell very small, elongate-ovate, bluish-white. Nuclear whorls small, deeply, obliquely immersed in the first of the succeeding turns above which only a portion of the tilted edge of the last portion projects. Postnuclear whorls almost flattened, very feebly shouldered at the summit, marked by rather strong, well elevated, obliquely, protractively slanting axial riblets, of which 18 occur upon the second and 20 upon the rest of the turns; these riblets terminate conspicuously at the summit which they render slightly crenulated. The spaces that separate the axial ribs are a little wider than the ribs; in addition to the axial sculpture, the whorls are marked by 4 spiral threads which are a little more than half the width of the spaces that separate them and which render the junction with the axial ribs feebly nodulose. The spaces enclosed between the axial ribs and spiral threads form conspicuously impressed, rounded pits. Suture well constricted. Periphery well rounded. Base moderately long, well rounded, marked by 12 spiral threads which grow consecutively feebler and more closely spaced from the periphery anteriorly; the spaces between these spiral threads are crossed by slender axial threads. Aperture broadly oval; outer lip thin; inner lip reflected over and appressed to the base for two-thirds of its length, marked with an oblique fold at its insertion; parietal wall covered with a thin callus.

The type (Cat. No. 367974 U. S. N. M.) has almost 6 whorls, and measures—length, 2.3 mm.; greater diameter, 1 mm.

Thericium browni, new species

Fig. I.—4.

Shell moderately large, brownish sooty, blotched with splashes of dark brown and white; these are usually arranged in alternating series so that on the base the tubercles are dark, while the spaces that separate them are light; the aperture is light smoky gray with alternating spots of brown and gray at the edge, some of which extend inward as streaks into the outer lip; the deeper portion of the outer lip is darker in tone than the outer edge. The early whorls have the sculpture eroded; on the next to the last it consists of a row of very strong tubercles which is about two-thirds of the distance between the summit and the suture anterior to the summit, and a row of finer tubercles a little below the summit; on the next to the last whorl the anterior row of tubercles is very strong, while on the last it is materially reduced; in addition to this sculpture the whorls are marked by numerous fine, somewhat wavy incised spiral lines. The base is about twice as long as the posterior portion of the last turn and is marked by 4 spiral series of tubercles which are brown while the spaces that separate these tubercles, which are a little larger than the tubercles, are white. On the base the spiral threads between the nodules, which are quite numerous, are a little stronger than those on the spire. Aperture irregular in outline, very strongly channeled anteriorly and moderately strongly channeled posteriorly; the callus on the parietal wall near the posterior angle forms a strong spiral lamella which forms a conspicuous channel between the posterior edge of this and the outer lip; the rest of the parietal wall is covered by a thin, translucent callus, while on the columellar lip the callus is thicker and smoky white; the outer lip is moderately expanded and curved almost in a semicircle.

The type (Cat. No. 367969 U. S. N. M.) has 5.5 whorls remaining, and measures—length, 23.1 mm.; greater diameter, 14.8 mm.

Alaba guayaquilensis, new species

Fig. I.—14.

Shell elongate-conic, the first four turns flesh-colored, the rest horn-brown with the varices flesh-colored; the interior of the aperture pale brown; the incised spiral lines are also flesh-colored. The first 3 whorls are well rounded, smooth, excepting incremental lines; beginning with the fourth, 5 incised spiral lines are present between the summit and suture. The whorls are marked at irregular intervals by strong, almost vertical varices; on the last turn there is one which crosses the entire whorl, preceded at almost regular intervals by 4 which extend but little beyond the deeply incised spiral lines anterior and posterior to the periphery. Suture slightly constricted. Periphery well rounded. Base moderately long, well rounded, marked by fine incremental lines and 5 strongly incised spiral grooves. Aperture broadly oval; posterior angle acute; outer lip thin at the edge with a strong varix immediately behind it; inner lip rather stout; parietal wall covered by a thin callus.

The type (Cat. No. 397981 U. S. N. M.) has 7 whorls, and measures—length, 5.7 mm.; greater diameter, 2.5 mm.

Fossarus guayaquilensis, new species

Fig. I.—6.

Shell small, helicoid, white. Nuclear whorls partly eroded. The later turns marked by 3 very strong spiral keels between summit and suture, and

3 additional strong spiral keels on the base; anterior to these 3 strong spiral keels near the edge of the columella are 2 additional spiral cords of considerably lesser strength than the keels; the space between the summit and the first spiral cord, which is almost on the middle of the turn between summit and suture, is marked by 7 slender spiral threads; 8 slender spiral threads are present between the first and second keel, 2 of these being on the anterior half of the first keel. The space between the second and third keel is marked by 10 spiral threads, of which 4 are present on the anterior half of the second keel, and 2 on the posterior half of the third; the space between the third and fourth keel is marked by 15 spiral threads, of which 5 very slender ones are present on the anterior half of the third and the posterior half of the fourth keel; the space between the fourth and fifth is marked by 10 spiral threads, of which 4 are on the anterior half of the fourth, and 4 in the space between the fourth and fifth keel, and 2 on the posterior half of the fifth keel; the space between the fifth and sixth keels is also marked by spiral threads; of these, 4 are on the anterior half of the fifth, and 3 in the space that separates them; anterior to this, the slender spiral threads are less conspicuous. In addition to the spiral sculpture, the whorls are marked by rather strong incremental lines amounting almost to riblets which give to the spaces between the strong spiral keels a somewhat cloth-like appearance. Base short, openly umbilicated; the umbilical wall is marked by strong incremental lines but devoid of spiral sculpture. Aperture of irregular outline, rendered strongly fluted by the spiral keels on the outer lip which is fairly thick; the inner lip is lunate, being slightly protracted at the anterior angle of the aperture and extending as a claw-like element at its junction with the outer lip on the parietal wall.

The type (Cat. No. 367971 U. S. N. M.) has 3.5 whorls remaining, and measures—length, 3.7 mm.; greater diameter, 4.1 mm.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

PHILOSOPHICAL SOCIETY

960TH MEETING

The 960th meeting was held at the Cosmos Club October 1, 1927.

Program: PAUL R. HEYL: *Wave mechanics.* The concept of the atom as set forth by Bohr involves the assumption that a revolving electron will not radiate energy. This assumption runs counter to accepted ideas, but has been tolerated because the Bohr atom works well.

The wave mechanics of Schrödinger furnishes us with a concept of the atom which is free from this objection and which retains all the good features of the Bohr atom. In addition it permits of half-quantum numbers which seem to be demanded by experimental evidence, but for which there was no room in Bohr's theory. It also gives a means of calculating the intensity of spectral lines, which no earlier theory was capable of doing. (*Author's abstract.*)

961ST MEETING

The 961st meeting was held at the Cosmos Club, October 15, 1927.

Program: CHESTER SNOW: *A magneto-electron theory of gravitation.* (This JOURNAL **17**: 457–464. 1927.)

A. J. HENRY: *Abnormal summers in the United States.* The summer of 1927 in Washington, D. C., was the third coolest in that city in the last 50-odd years. This fact led to a short statistical study of abnormal summer temperatures, not only in Washington but elsewhere in the United States.

This study was based upon thermometric observations mainly for the 50-odd years since the early seventies and on observations for more than 100 years at two New England stations, New Haven, Conn., and New Bedford, Mass. It was shown that abnormal summers are rarely, if ever, general over the entire continental United States but tend rather to be localized in certain sections of the area, cool summers in the region extending eastward from the lower Missouri Valley to the eastern seaboard and warm summers more in the central areas west of the Appalachians and east of the Rocky Mountains. The range in the summer means is least on the coast and greatest in the interior. The extreme oscillation in the summer mean (the mean of June, July and August) is eleven degrees at Saint Paul, Minn., and the smallest oscillation is about half that amount at San Francisco and Santa Fe, New Mex.

The outstanding cool summer for New England, the only part of the country which has a thermometric record of more than 100 years was that of 1816, although the summer of 1812 at Salem, Mass., was cooler. For the remainder of the country there have been four noteworthy cool summers in the last 50-odd years, viz., those of 1903, 1907, 1915 and 1927. Of these 1915 was the coolest, 1903 the second coolest and 1927 the fourth. Warm summers have been distributed quite irregularly and more or less locally. The summer of 1926 at Portland, Oregon, was the warmest ever experienced; at San Francisco, the highest mean was reached in 1888 and at San Diego in 1871. East of the Rockies there was a group of warm summers 1889–1901, also in the middle seventies and again in 1919–1920. (*Author's abstract.*)

962D MEETING

The 962d meeting was held at the Cosmos Club October 29, 1927.

Program: H. B. MARIS: *A theory of the upper atmosphere and meteors.* The force of gravity acting on the atmosphere of the earth causes the heavier gases to settle downward and the lighter gases to rise to higher altitudes by diffusion, and winds unhindered by diffusion would by convection keep the composition of the air uniform at all elevations. The classical ideas of the change in atmospheric pressure with altitude (e.g. Humphreys, Jeans, Chapman and Milne, etc.) have been based on the assumption that convection is negligible, at least in the upper atmosphere, and that each gas was through diffusion in gravity equilibrium with its own partial pressure. Investigation has shown, however, that diffusion is of importance only at elevations greater than 100 km.

The ordinary equations of diffusion show at once that if the air were uniformly mixed at all altitudes and then left free from all convection currents, there would be a constant flow of lighter molecules upward and of heavier molecules downward, which would be independent of the altitude until a level was reached where the diffusing gas would be in gravity equilibrium. This "diffusion" level for hydrogen would move from infinity down to 142 km. in one day, at the end of five days it would be at a height of 127 km. and in 50 days it would be at 113 km. The corresponding levels for helium would be at 137, 120 and 106 km. respectively. The new calculations give hydrogen and helium contents above 150 km. roughly 1/100,000 of the values previously calculated.

Recent use of the upper atmosphere as a medium for transmitting electromagnetic radiation of wave-length 10 to 10,000 meters has emphasized the importance of knowledge or at least of a theory of changes which occur in the upper atmosphere between day and night conditions during different seasons of the year. Absorption of solar and terrestrial radiation by the air must determine any theory of temperature distribution in the upper atmosphere. Humphreys has discussed this problem and has suggested that it should have been worked out but no attempt has been made previously to apply radiation and absorption coefficients and solve for the thermal condition of the upper atmosphere or to estimate probable temperatures at elevations greater than 20 km. for the radiation conditions of day and night or winter and summer.

Water vapor above 11 km. absorbs a little over 20 per cent of black body radiation from below at earth temperatures while carbon dioxide absorbs nearly 40 per cent. Ozone absorbs only about 2 per cent but its presence is important because it absorbs about 4 per cent of the solar radiation at an altitude where most of the re-radiation must be by the ozone itself. Temperature calculations based on these absorption coefficients show that for a 50° latitude above a height of sixty kms. we should expect a temperature of about 250°K during a winter day with a drop to 220° during the night. The atmosphere at the base of the stratosphere cannot be in radiation equilibrium, but it must receive more radiant energy than it loses both from above and below during a 24 hour day. The temperature condition of the earth's surface is in very unstable equilibrium. The loss in heat by radiation from the warm equator is much less than from the cooler polar regions. An increase in temperature at sea level near the equator would not result in an increase in the energy lost by radiation from these regions, but would actually result in a decrease. Loss of heat by radiation from the earth depends, not on the condition of the surface, but on the temperature at the base of the stratosphere and absorption in the stratosphere. A slight change in the carbon dioxide of the air would have a tremendous influence on the climate of the earth. If the carbon dioxide content of the air were increased from the present 0.03 per cent to 0.1 per cent tropical plants would probably grow in the polar regions. On the other hand if this protecting sheet decreases from 0.03 per cent to 0.01 per cent, ice would probably be found near the equator.

Since the present theory leads to low densities of the atmosphere above heights of 100 km., densities one hundred thousandth of those of classical tables at 300 km., the facts about the appearance of meteors require explanation. It seems possible to do this following to a certain extent the ideas of Sparrow and to a certain extent those of Lindemann. When a high speed meteor strikes an air molecule, it is assumed that the energy of the impact violently ejects atoms, molecules and possibly small particles of molecular dimension from the body of the meteor. This ejected material by virtue of its velocity carries into the air the energy which eventually gives the light of the meteor trail. For example, when a nitrogen molecule strikes an iron meteor which has a velocity of 40 km. per second, the energy of the impact is sufficient to raise the temperature of 1800 molecules 1000°C. or to evaporate 56 molecules of iron, or to evaporate and ionize 24 molecules of iron. As a result of this impact a mass many times that of the nitrogen molecule is ejected from the meteor principally in the form of highly energized iron atoms which have velocities slightly greater than that of the meteor itself. The inelastic collisions of these iron atoms with the molecules of the air result in the visible trail. The excitation energy of these collisions may be as high

as 155 volts for nitrogen or 280 volts for argon. Much of this energy may be radiated in the ultra-violet or even soft X-ray region, and it is probable that not more than one-tenth of the total radiation is in the visible part of the spectrum. Therefore, the total mass of the meteor must be much more than that derived by Lindemann and Dobson from their considerations of the relation between the mass of a meteor and its light. The temperature changes in the upper atmosphere from evening to morning, and from winter to summer, given by the present theory leads one to expect appearance of meteors at heights which are greater by say 5 km. in the evening than in the morning and in the summer than in the winter. It would be interesting to know whether this difference has been observed.

Recent studies of the propagation of electromagnetic waves over the earth's surface have emphasized the need of a theory and definite conclusions concerning diurnal and seasonal changes in temperature and composition of the atmosphere at heights greater than 50 km. It is the purpose of this discussion to take what steps are possible toward the meeting of this need. (*Author's abstract.*)

F. WENNER: *A principle governing the distribution of electric current in systems of linear conductors.* A brief resume is given of the procedures which have been developed for determining the distribution of direct current in systems of linear conductors. In this connection reference is made to practically all the laws, theorems, principles and procedures generally considered to pertain to this particular field of investigation. Consideration is then given to a principle which when employed usually leads more directly to the solution of problems than does any of the procedures commonly used.

This principle applies to systems of linear conductors in which the currents are proportional to the impressed electromotive forces; the electromotive forces may be any function of time, and may be distributed in any manner throughout the system; and the branches may contain resistance, inductance, capacitance or any two or all of these in series, may be so arranged as to move with respect to a permanent magnet, thus developing counter electromotive forces, and may be connected by contacts or mutual inductances or both of these. For such a system of conductors the current in any branch is that which would result if all impressed electromotive forces were replaced by a single impressed electromotive force, located in the particular branch and equal to the drop in potential which originally would have appeared across the break had this branch been opened. While this principle is a logical consequence of well-known laws, it has been used but very little and seems to be practically unknown. It is shown here that it may be used to advantage in all or practically all cases in which the conductors form a series-parallel combination or a network which may be changed to a series-parallel combination by opening the branch in which it is desired to determine the current. (*Author's abstract.*)

963D MEETING

The 963d meeting was held at the Cosmos Club November 12, 1927.

Program: HOWARD S. RAPPLEYE: *Observer's patterns.* In the work of first-order leveling as carried on by the U. S. Coast and Geodetic Survey the rods are read by estimating tenths of centimeter gradations. Each rod is read at three points. The height of the instrument and consequently the height at which the rods are read being purely accidental there should be about an even distribution among the ten digits in the resulting estimated

millimeters. This paper is a preliminary statement of results obtained by tabulating over 30,000 separate estimations of millimeters.

The results were grouped for different observers and for different observing conditions. The diagrams or "patterns," by means of which the results were shown, displayed some startling differences between the work of different observers and even for the same observers under different observing conditions.

The possibility of devising a test, to determine the fitness of a particular observer for this class of work, before taking the field with a level party was discussed. Certain other practical results, such as a limit on the length sight, which may possibly arise from this investigation were noted. (*Author's abstract.*)

JAMES STOKLEY: *The optical planetarium.*

In an informal communication FREDERICK E. BRASCH spoke of the "Newton Commemoration Program" and accompanying exhibits at the American Museum of Natural History.

H. E. MERWIN, *Recording Secretary.*

BIOLOGICAL SOCIETY

709TH MEETING

The 709th meeting of the Biological Society was held in the assembly hall of the Cosmos Club October 22, 1927 at 8:10 p.m., with Vice-president WETMORE in the chair and 63 persons present. Under suspension of the rules W. H. WHITE was elected to membership. The chairman announced the resignation of Dr. T. E. SNYDER as Corresponding Secretary and expressed the gratitude of the Society for his faithful service. On motion of S. A. ROHWER, WM. H. WHITE was elected Corresponding Secretary for the remainder of Dr. SNYDER's term.

T. S. PALMER called attention to the 45th Annual Meeting of the American Ornithologists Union to be held in Washington November 14–17.

A. WETMORE stated that a dead specimen of a rare shrew, *Sorex fontinalis*, was picked up about three weeks ago by Miss MARGARET WETMORE, in the path along the Canal at Lock 11. This is the westernmost record for the species in this region.

J. M. ALDRICH: *Collecting flies in the West* (illustrated).—The speaker described his experiences during the past summer in collecting diptera on a cross-country automobile trip, making special reference to accommodations for tourists at the auto camps along the road, and illustrating his talk with a number of lantern slides. In discussion, C. W. STILES called attention to the fact that public auto camps, unless strictly supervised by State officials, are likely to become menaces to public health.

H. C. OBERHOLSER: *The lure of the waterfowl* (illustrated).—Owing to the difficulties in their study, the waterfowl are one of the most fascinating groups to the bird student. The speaker, in the course of his travels over the country, has found a widespread interest in their conservation. The problems presented by the concentration of waterfowl in restricted areas during the winter, and by the preservation of sufficient marshland for breeding purposes, were described and illustrated by photographs. The German carp, which has been introduced in many of their favorite resorts, has greatly diminished the supply of available food for ducks and geese. Monthly censuses of waterfowl are now being taken on designated days at stations scattered throughout the United States and Canada, and are expected to

afford definite information as to the number of ducks and other waterfowl in the country. Lantern slides of a number of the favorite resorts of waterfowl were shown.

S. F. BLAKE, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

Dr. J. WALTER FEWKES retired as Chief of the Bureau of American Ethnology, Smithsonian Institution, on January 15. His retirement will allow him to complete manuscripts on certain field researches already accomplished, and he will at the same time continue to cooperate in the work of the Bureau.

A meeting to commemorate the life and services of CHARLES DOOLITTLE WALCOTT, Secretary of the Smithsonian Institution from 1907 to 1927, was held in the Auditorium of the Natural History Building, January 24, Chief Justice TAFT presiding. Addresses were delivered by JOHN C. MERRIAM, JOSEPH S. AMES, GEORGE OTIS SMITH, and CHARLES G. ABBOT.

The Petrologists' Club met at the Geophysical Laboratory on January 17. Prof. WALDEMAR LINDGREN of the Massachusetts Institute of Technology, at present chairman of the Division of Geology and Geography of the National Research Council, spoke on *Hot springs and magmatic emanations.*